US008331832B2

(12) **United States Patent**
Ikeda et al.

(10) **Patent No.: US 8,331,832 B2**
(45) **Date of Patent: Dec. 11, 2012**

(54) **DEVELOPING DEVICE, ASSEMBLY BODY, AND IMAGE FORMING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 293 days.

(21) Appl. No.: **12/875,598**

(22) Filed: **Sep. 3, 2010**

(65) **Prior Publication Data**

US 2011/0222918 A1 Sep. 15, 2011

(30) **Foreign Application Priority Data**

Mar. 15, 2010 (JP) 2010-057687

(51) **Int. Cl.**
G03G 15/09 (2006.01)

(52) **U.S. Cl.** **399/269**

(58) **Field of Classification Search** 399/267, 399/269, 273, 274, 275, 277
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,813,462	B2 *	11/2004	Mitsuya et al.	399/269
7,466,946	B2 *	12/2008	Tsujita et al.	399/269
2006/0216069	A1	9/2006	Tsujita et al.	

FOREIGN PATENT DOCUMENTS

JP	A-2006-47840	2/2006
JP	A-2006-267891	10/2006
JP	A-2007-47640	2/2007
JP	A-2007-164066	6/2007

* cited by examiner

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(57) **ABSTRACT**

A developing device includes: a first-developer-holding-member facing a surface of a rotating latent image carrier, it rotating such that a moving direction thereof is opposite to that of the carrier at a portion where they face; a second-developer-holding-member provided at a downstream-side of the first-developer-holding-member in a direction in which the carrier rotates, and facing the surface of the carrier, it rotating such that a moving direction thereof is the same as that of the carrier at a portion where they face; a ratio of circumferential speeds of the first-developer-holding-member and the second-developer-holding-member being variable; a splitting member that splits a developer for the first-developer-holding-member and the second-developer-holding-member by hitting against the developer located between the first-developer-holding-member and the second-developer-holding-member; a moving unit that moves the splitting member; and a control unit that controls the moving unit to move the splitting member to vary split ratio of the developer.

20 Claims, 7 Drawing Sheets

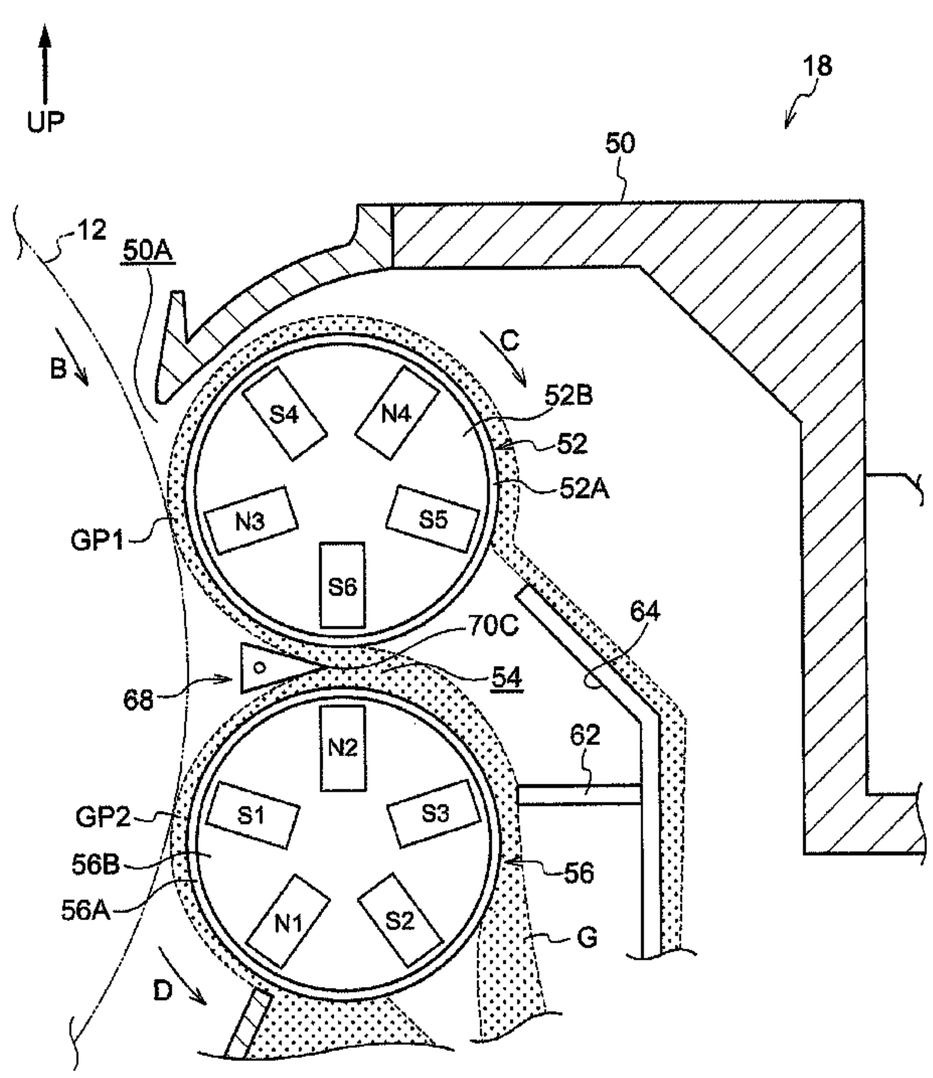

FIG.1

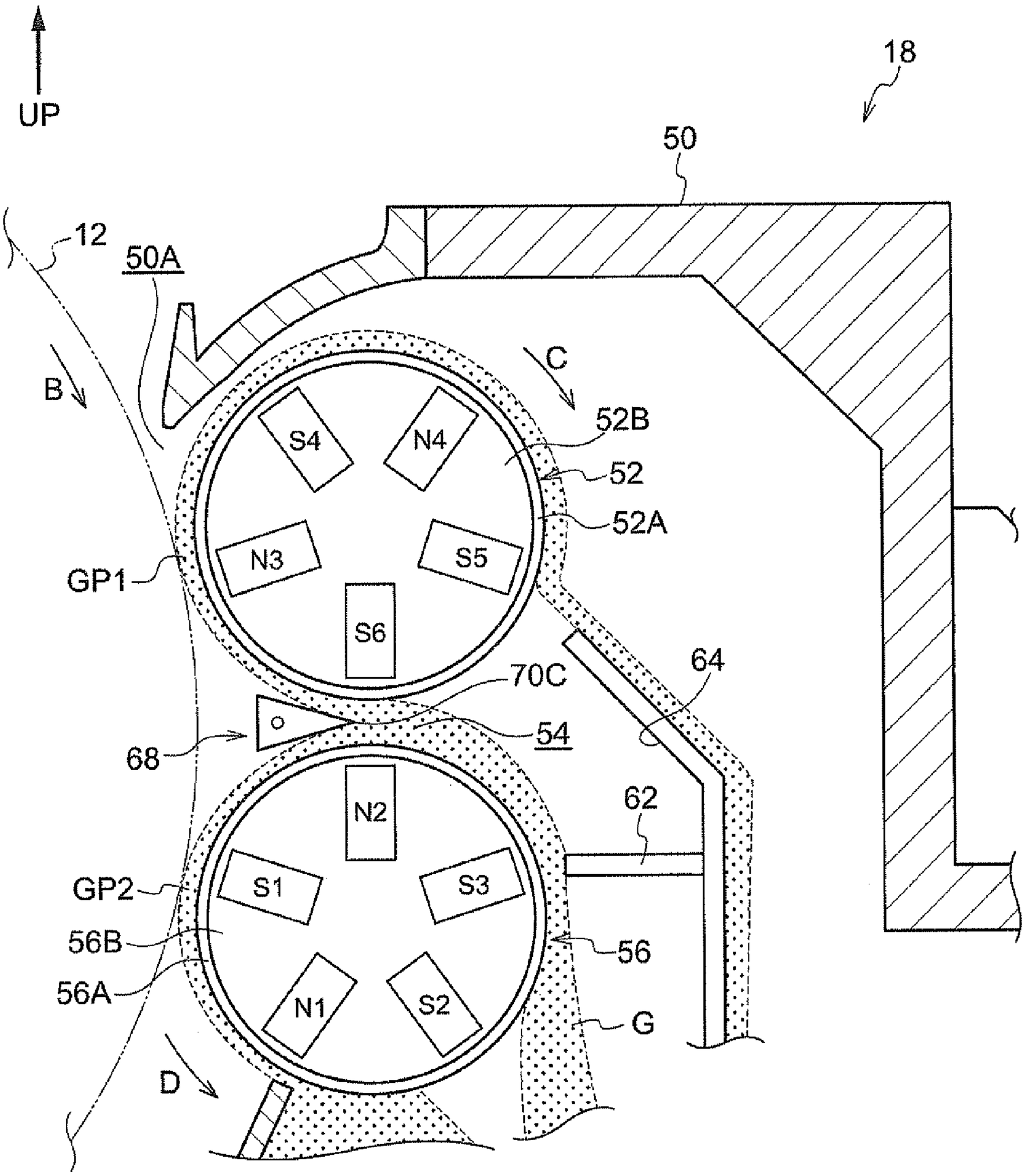
UP
18
50
12
50A
B
C
52B
52
52A
S4
N4
N3
S5
S6
GP1
70C
64
54
68
62
N2
S1
S3
GP2
56B
56
56A
N1
S2
G
D

FIG.2

18
60
52
64
56
G
54
62
C
58
(50B)
50
50B
S
N
S
S
N
S
S
S
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52B
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GP2
56B
56A
D
50A
B
12
UP

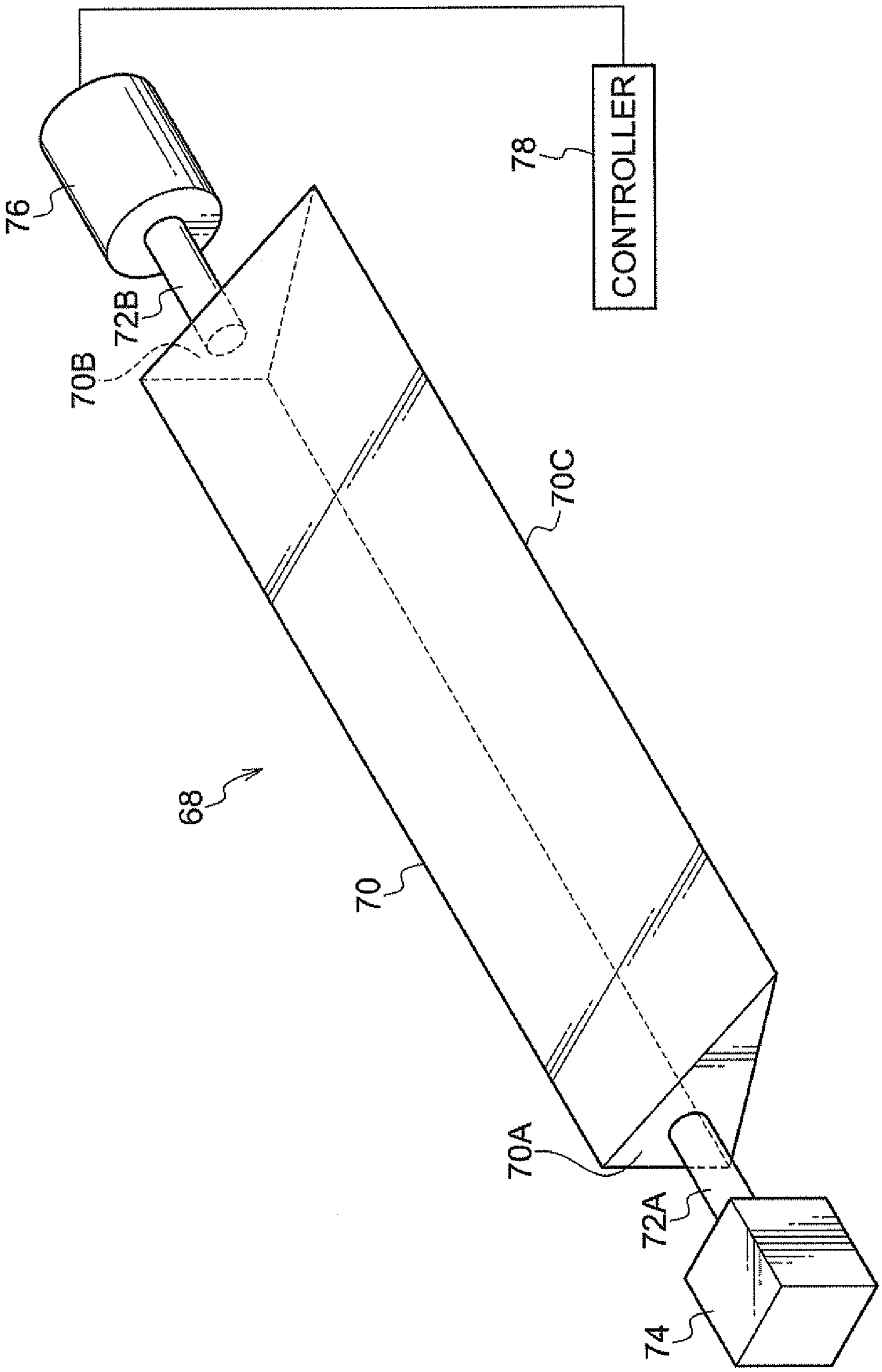


FIG.3

FIG.4C

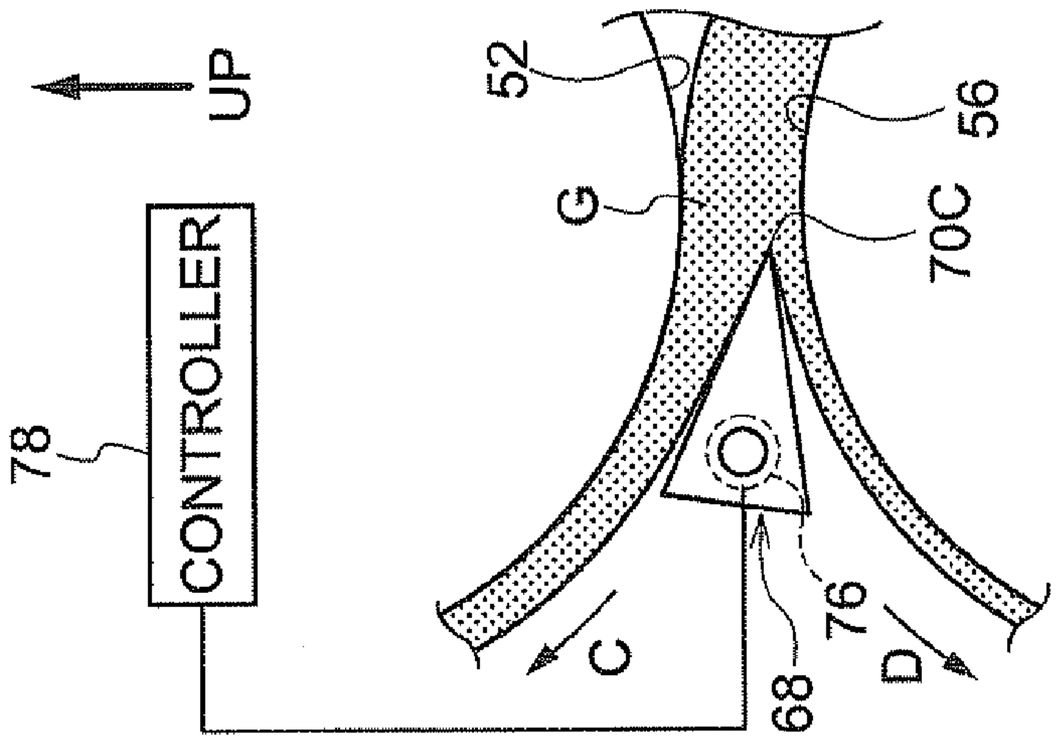


FIG.4B

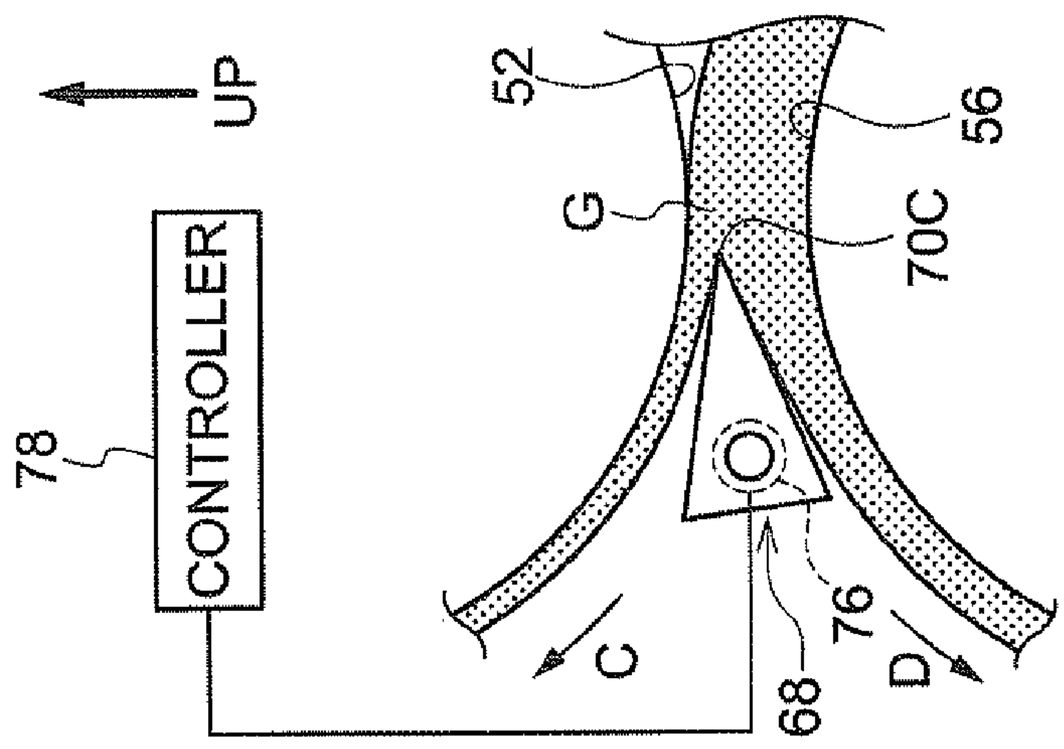


FIG.4A

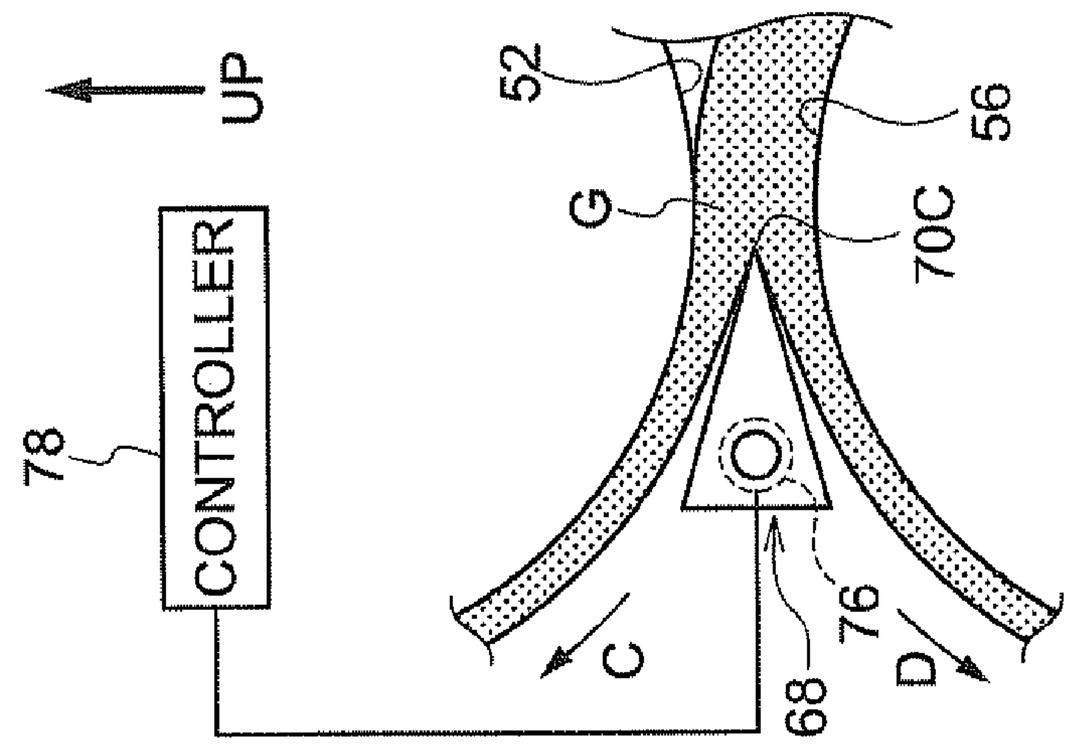
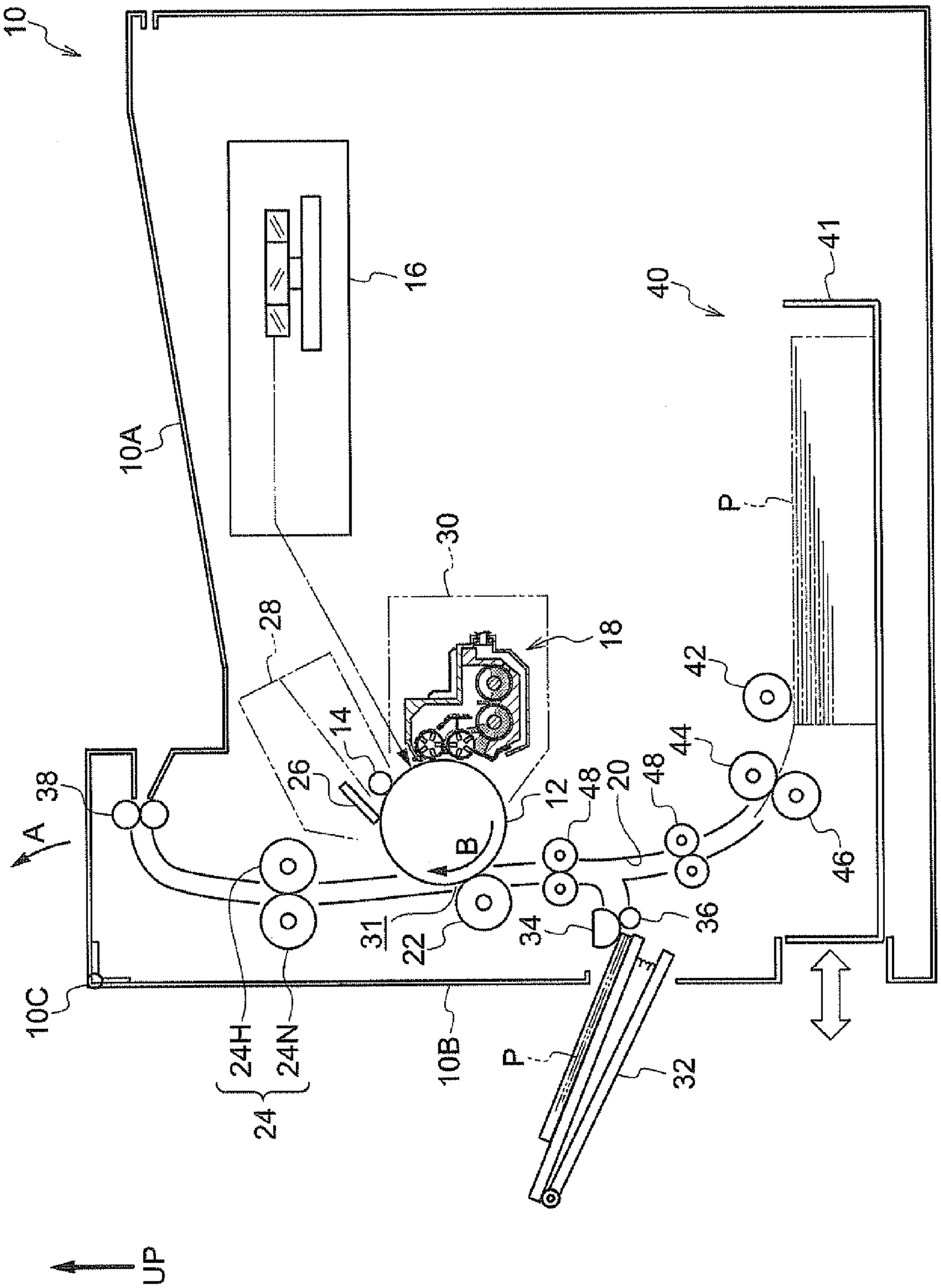


FIG.5


10
16
40
41
10A
30
28
18
42
14
26
44
38
A
12
48
20
48
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46
31
22
34
36
10C
24H
24N
24
10B
P
32
UP

FIG.6

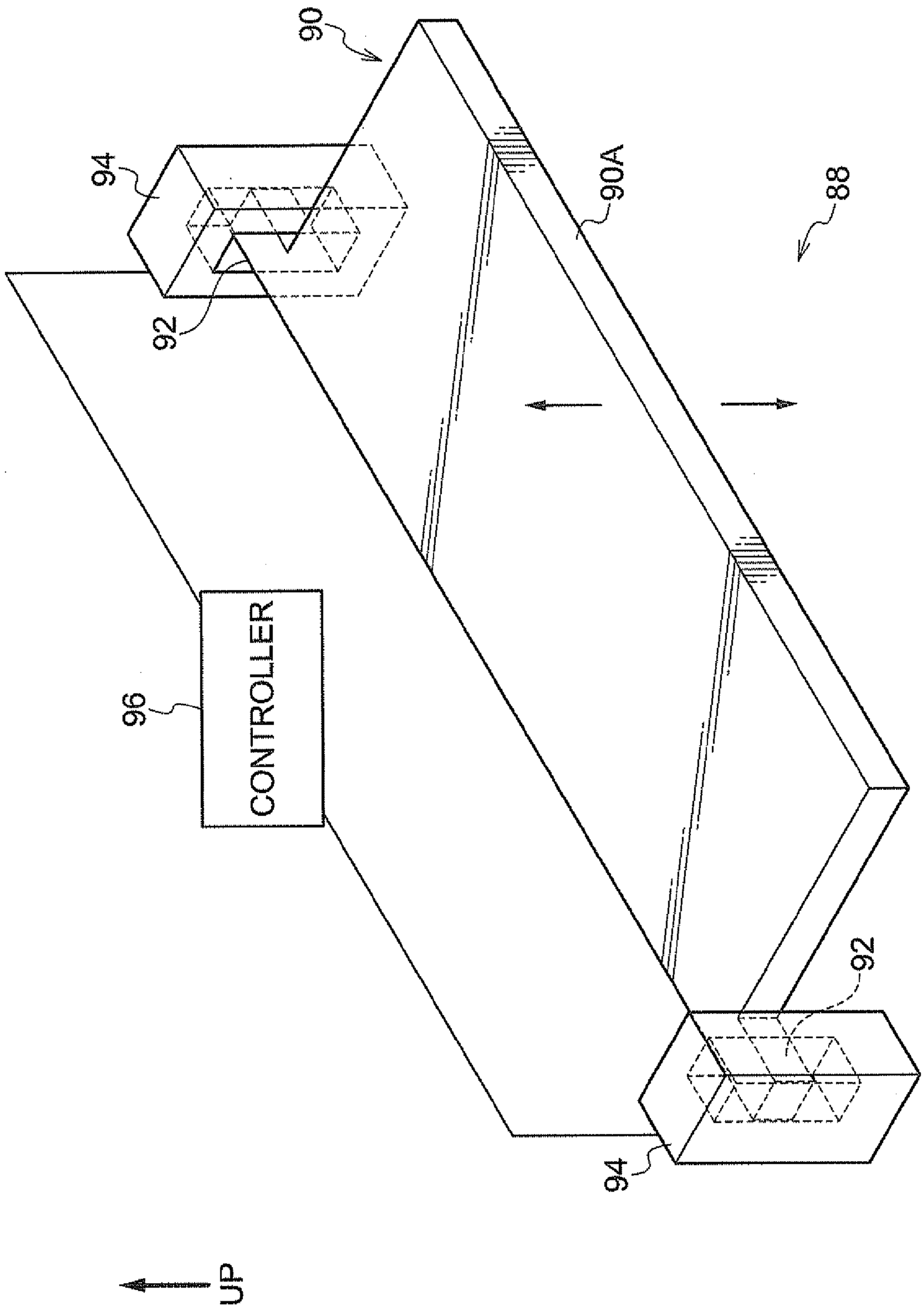


FIG.7C

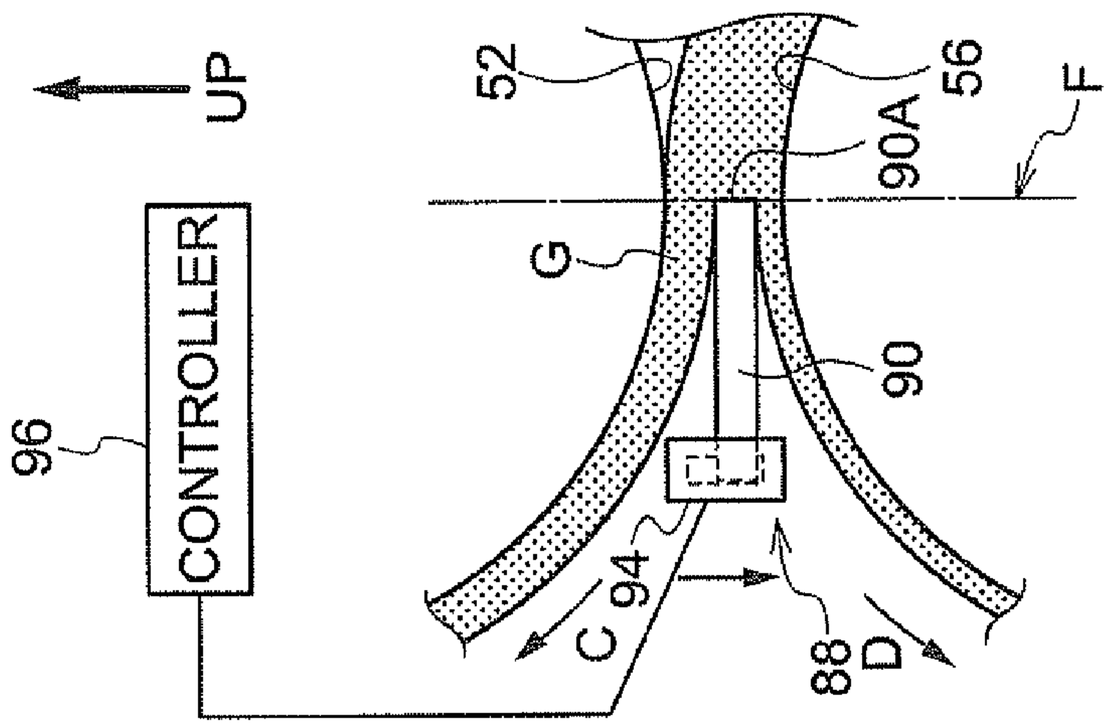


FIG.7B

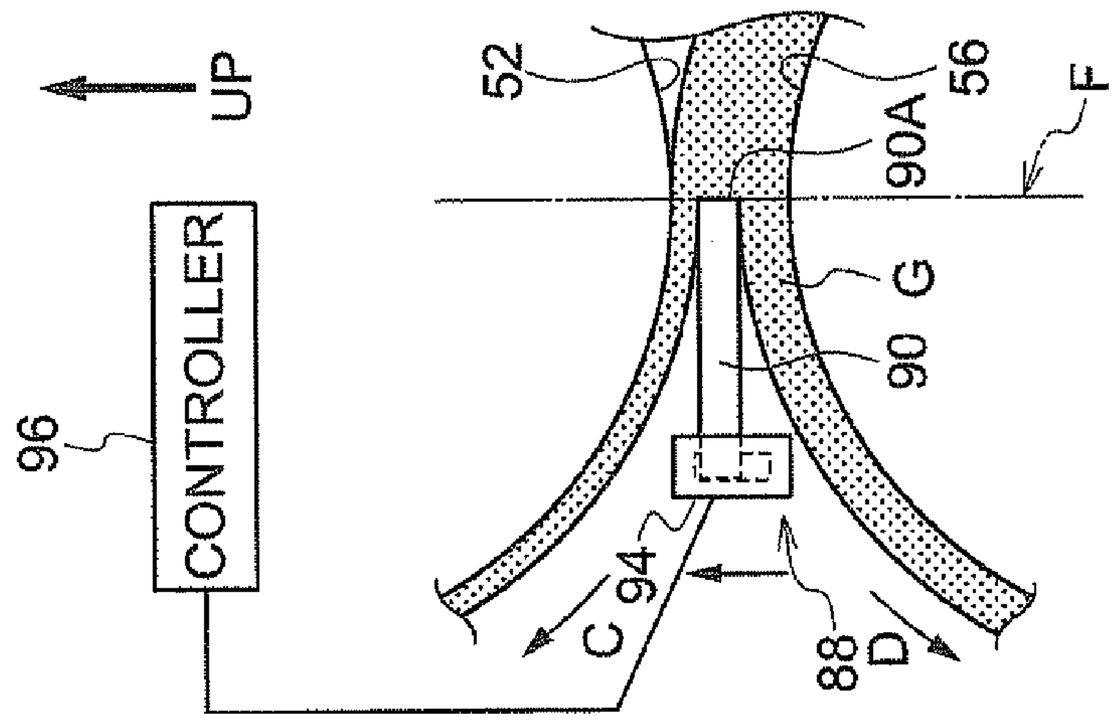
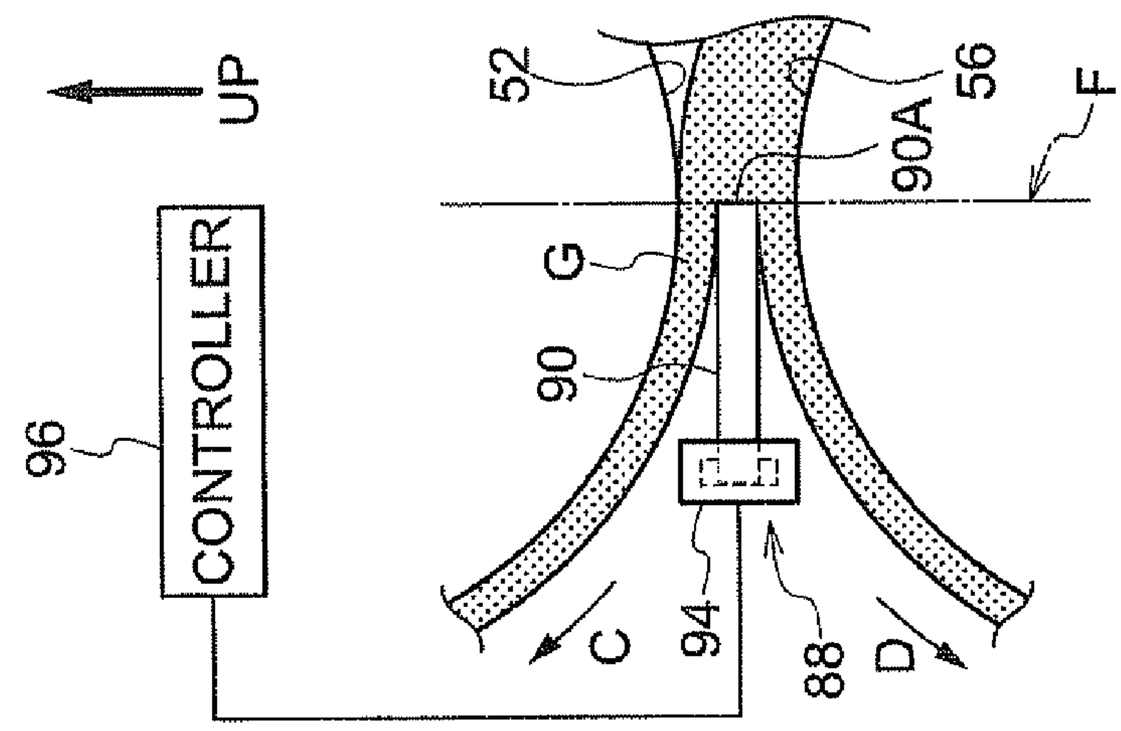


FIG.7A



DEVELOPING DEVICE, ASSEMBLY BODY, AND IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2010-57687 filed on Mar. 15, 2010.

BACKGROUND

1. Technical Field

The present invention relates to a developing device, an assembly body and an image forming apparatus.

2. Related Art

SUMMARY

A developing device according to an aspect of the invention includes: a first developer holding member that is disposed to face a surface of a latent image carrier that rotates, the first developer holding member rotating such that a moving direction of the first developer holding member is opposite to that of the latent image carrier at a portion where the latent image carrier and the first developer holding member face each other; a second developer holding member that is provided at a downstream side of the first developer holding member in a direction in which the latent image carrier rotates, and is disposed to face the surface of the latent image carrier, the second developer holding member rotating such that a moving direction of the second developer holding member is the same as that of the latent image carrier at a portion where the latent image carrier and the second developer holding member face each other, and a ratio of circumferential speeds of the first developer holding member and the second developer holding member being variable; a splitting member that splits developer for the first developer holding member and the second developer holding member at a position between the first developer holding member and the second developer holding member, by hitting against the developer located between a surface of the first developer holding member and a surface of the second developer holding member; a moving unit that moves the splitting member; and a control unit that controls the moving unit to move the splitting member so as to vary a split ratio of the developer.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the invention will be described in detail with reference to the following figures, wherein:

FIG. **1** is a side view showing developing rolls, a separating member and the like of a developing device according to a first exemplary embodiment of the present invention.

FIG. **2** is a side view showing a developing device according to a first exemplary embodiment of the present invention.

FIG. **3** is a perspective view showing a separating member and the like used in a developing device according to a first exemplary embodiment of the present invention.

FIGS. **4**A, **4**B and **4**C are side views each showing a separating member used in a developing device according to a first exemplary embodiment of the present invention.

FIG. **5** is a schematic structural view showing an image forming apparatus, an assembly body and the like according to a first exemplary embodiment of the present invention.

FIG. **6** is a perspective view showing a separating member and the like used in a developing device according to a second exemplary embodiment of the present invention.

FIGS. **7**A, **7**B and **7**C are side views each showing a separating member used in a developing device according to a second exemplary embodiment of the present invention.

DETAILED DESCRIPTION

One example of each of a developing device, an assembly body and an image forming apparatus according to a first exemplary embodiment of the present invention is described with reference to FIGS. **1** through **5**. Note that arrow UP shown in these drawings indicates an upper side in the vertical direction.

(Overall Structure)

As shown in FIG. **5**, an image forming apparatus **10** includes: a latent image carrier **12** which is electric-charged evenly, and thereafter, causes an electrostatic latent image to be formed on a surface thereof by being irradiated with laser light; a charging device **14** which electric-charges the surface of the latent image carrier **12** evenly; an exposure device **16** in which the latent image carrier **12** is irradiated with laser light based on image data, so as to form an electrostatic latent image; and a developing device **18** in which a toner is selectively transferred to the electrostatic latent image and a latent image is made visible as a toner image; a transfer roll **22** which transfers the toner image on the surface of the latent image carrier **12** to a sheet member P serving as a recording medium supplied along a transport path **20**; a fixing device **24** in which the toner image on the sheet member P is heated and pressurized, and fixed on the sheet member P; and a cleaning device **26** which cleans a toner remaining on the latent image carrier **12** after the toner image is transferred. The developing device **18** is described later in details.

Further, the image forming apparatus **10** is covered by a main body side surface cover **1013** and a top plate **10**A. A shaft **10**C is provided at an upper end corner portion of the main body side surface cover **1013** and connects the top plate **10**A to the main body side surface cover **10**B in a rotatable manner. By the top plate **10**A being rotated around the shaft **10**C in the direction indicated by arrow A, the inside of the image forming apparatus **10** is opened.

Here, the charging device **14** and the cleaning device **26** are formed as one charging unit **28**, and the developing device **18** and the latent image carrier **12**, each provided as an assembly body, are formed as an exchangeable cartridge **30**. With the top plate **10**A of the image forming apparatus **10** being opened, the charging unit **28** and the exchangeable cartridge **30** are each attachable/removable with respect to a main body frame (not shown) inside of the image forming apparatus **10**.

Further, a manual paper feed pedestal **32** is provided at the side of the image forming apparatus **10** and allows manual feeding of the sheet member P to an image forming portion **31** formed by the latent image carrier **12** and the transfer roll **22**. The manual paper feed pedestal **32** is provided with a delivery roll **34** having a half-moon-shaped configuration. In addition, a separating roll **36** is provided with respect to the delivery roll **34** with the sheet member P interposed therebetween.

The separation roll **36** is axially supported by supporting members (not shown) provided at both end portions thereof, and is urged by means of urging force of coil springs provided within the supporting members, toward the delivery roll **34**. Due to the above-described structure, when the delivery roll **34** rotates, the sheet members P placed on the manual paper feed pedestal **32** are fed one by one to the image forming portion **31** by the delivery roll **34** and the separation roll **36**.

Moreover, a paper feed device **40** which feeds the sheet members P one by one is provided at the lower side within the image forming apparatus **10**. The paper feed device **40** is provided with a paper feed member **41** in which plural sheet members P are superimposed, and has a structure in which the sheet members P stacked in the paper feed member **41** are sequentially taken out by a take-off roll **42** and are transported one by one by a paper feed roll **44** driven to rotate and a separating roll **46** provided in the paper feed member **41**.

Plural transport rolls **48** are provided along the transport path **20** of the sheet member P, and the sheet member P is transported to the downstream side in the transport direction of the sheet member P along the transport path **20**.

The above-described fixing device **24** is provided at the downstream side of the image forming section **31**. The fixing device **24** includes a heating roll **24**H and a pressure applying roll **24**N. Due to the sheet member P passing through between the heating roll **24**H and the pressure applying roll **24**N, the toner image on the sheet member P is fixed on the sheet member P.

Further, an exhaust roll **38** is provided at the downstream side of the fixing device **24** and discharges the sheet member P having the toner image fixed thereon to the upper surface of the top plate **10**A.

In the image forming apparatus **10** having the above-described structure, an image is formed in such a manner as described below.

First, the charging device **14** to which a voltage is applied charges negative the surface of the latent image carrier **12** at an intended potential with uniformity. Subsequently, based on image data read by a scanner (not shown) or data input form outside, the charged surface of the latent image carrier **12** is exposed by the exposure device **16**, and an electrostatic latent image is formed on the surface of the latent image carrier **12**.

In other words, based on video data supplied from a control device (not shown), laser of the exposure device **16** is switched on or off, whereby an electrostatic latent image corresponding to image data is formed on the latent image carrier **12**. Further, this electrostatic latent image is made visible as a toner image by the toner supplied from the developing device **18**.

Consequentially, the sheet member P taken out from the paper feed member **41** by the take-off roll **42** is sent, by the paper feed roll **44** and the separating roll **46**, to the transport roll **48** one by one and is delivered to the transport path **20**. The sheet member P delivered to the transport path **20** passes through the image forming portion **31** formed between the latent image carrier **12** and the transfer roll **22**, and the toner image is transferred to the sheet member P. The transferred toner image is fixed on the sheet member P by passing through between the heating roll **24**H and the pressure applying roll **24**N, and is discharged by the exhaust roll **38** to the upper surface of the top plate **10**A.

Incidentally, in the image forming apparatus **10** of the present exemplary embodiment, one developing device **18** is provided, but in a case in which a color image is formed, developing devices **18** corresponding to four colors of yellow (Y), magenta (M), cyan (C), and black (K) are disposed at positions each facing the latent image carrier **12**.

(Structure of Main Part)

Next, the structure of the developing device **18** is described.

As shown in FIG. **2**, the developing device **18** is provided with a case body **50** having an opening portion **50**A at a position which faces the latent image carrier **12**. A first development roll **52**, which is an example of a first developer holing member, is accommodated in the case body **50**. The first development roll **52** is disposed to face the surface (the outer peripheral surface) of the latent image carrier **12**. The first development roll **52** rotates in the same direction as the rotating direction of the latent image carrier **12** rotating in the direction indicated by arrow B, that is, a direction in which the first development roll **52** moves in a development nip GP**1** which faces the latent image carrier **12** is opposite to a direction in which the latent image carrier **12** moves thereat (that is, a direction indicated by arrow C). The first development roll **52** holds a developer G on the surface (the outer peripheral surface) thereof,

Further, a second development roll **56**, which is an example of a second developer holding member, is also accommodated in the case body **50** below the first development roll **52**. The second development roll **56** is disposed to face the surface of the latent image carrier **12**. The second development roll **56** rotates in a direction opposite to the rotating direction of the latent image carrier **12**, that is, a direction in which the second development roll **56** moves in a development nip GP**2** which faces the latent image carrier **12** is the same as the direction in which the latent image carrier **12** moves thereat (i.e., the direction indicated by arrow D). The second development roll **56** holds the developer G on the surface (outer peripheral surface) thereof.

In addition, a first agitation-transport auger **58** and a second agitation-transport auger **60**, which are arranged in lined up manner and transport the developer G to the second development roll **56**, are provided in an accommodation chamber **50**B, provided at the lower side within the case body **50**, which accommodates the developer G therein.

The first agitation-transport auger **58** and the second agitation-transport auger **60** are arranged in lined up manner at the lower side of the second development roll **56** (at the lower right side of the figure) so as to circulate and transport the developer G. By the first agitation-transport auger **58** and the second agitation-transport auger **60** rotating, the developer G is transported along a rotation-axis direction of the second development roll **56** while being agitated. Thus, the developer G is supplied to the second development roll **56**. The developer G used in the developing device **18** contains a toner made from resin, and magnetic carrier particles, as principal components thereof.

Further, the first development roll **52** provided above the second development roll **56** is disposed so as to face the surface of the latent image carrier **12** such that the rotation-axis direction of the first development roll **52** is set along the rotation-axis direction of the latent image carrier **12**. The first development roll **52** includes a tube-shaped first development sleeve **52**A and a circular column-shaped first magnet roll **52**B. A direction in which the tube-shaped first development sleeve **52**A moves in the development nip GP**1** which faces the latent image carrier **12** is opposite to a direction in which the latent image carrier **12** moves thereat. The circular column-shaped first magnet roll **52**B is disposed inside of the first development sleeve **52**A and forms magnetic field so as to be distributed at the outer side of the first development sleeve **52**A in the circumferential direction. As a result, the first development roll **52** causes a toner to be developed by an electric field on a latent image of the latent image carrier **12** in the development nip GP**1** facing the latent image carrier **12**.

The circumferential speed of the first development sleeve **52**A can be varied. In the present exemplary embodiment, for the purpose of improving development properties, the circumferential speed of the first development roll **52** is determined such that the circumferential speed ratio of the first

development roll **52** (the first development sleeve **52**A) with respect to the latent image carrier **12** is set in the range of 0.7 to 2.0.

The second development sleeve **56**A is disposed so as to face the surface of the latent image carrier **12** at the downstream side of the first development roll **52** in the direction in which the latent image carrier **12** rotates, such that the rotation-axis direction thereof is set along the rotation-axis direction of the latent image carrier **12**. The second development roll **56** includes a tube-shaped second development sleeve **56**A and a circular column-shaped second magnet roll **56**B. A direction in which the second development sleeve **56**A moves in the development nip GP**2** facing the latent image carrier **12** is the same as the direction in which the latent image carrier **12** moves thereat. The second magnet roll **56**B is disposed inside of the second development sleeve **56**A and forms magnetic fields so as to be distributed in the circumferential direction at the outer side of the second development sleeve **56**A. As a result, the second development roll **56** causes a toner to be developed by an electric field on a latent image of the latent image carrier **12** in the development nip GP**2** facing the latent image carrier **12**.

The circumferential speed of the second development sleeve **56**A can be varied. In the present exemplary embodiment, in order to adjust image quality, the circumferential speed of the second development roll **56** is determined such that the circumferential speed ratio of the second development roll **56** (the second development sleeve **56**A) with respect to the latent image carrier **12** is set in the range of 1.0 to 2.5.

The first development roll **52** and the second development roll **56** are disposed to face each other such that a clearance is formed between the outer periphery of the first development sleeve **52**A and the outer periphery of the second development sleeve **56**A. A delivery portion **54** in which delivery of the developer G held on the surface of the second development sleeve **56**A and transported is performed is formed between the first development sleeve **52**A and the second development sleeve **56**A (in a minimum clearance portion).

Further, a layer forming member **62** is disposed at the upstream side of the delivery portion **54** in the direction in which the second development roll **56** rotates. The layer forming member **62** faces the surface of the second development roll **56**, and allows adhesion of a proper amount of developer and flattens uniformly a developer layer in the axial direction. The layer forming member **62** is made from a plate material having a rectangular cross section taken along the normal-line direction of the outer periphery of the second development roll **56**. One side surface of the rectangular section of the layer forming member **62** is disposed so as to face the surface of the second development roll **56** and the other side surface is fixed to a guide plate **64** provided within the case body **50**.

The guide plate **64** is provided such that the leading end portion thereof is disposed so as to face the first development roll **52** and the other end portion extends down toward the first agitation-transport auger **58**. The guide plate **64** is configured so as to drop down the developer G dropping out of the first development roll **52** toward the accommodation chamber **50**B. In other words, the developer G dropping out of the first development roll **52** drops down toward the accommodation chamber **50**B without immediately adhering again to the second development roll **56**, and is agitated with the developer in the developer accommodation chamber.

As shown in FIG. **1**, five permanent magnets each having an S-pole or an N-pole formed on the surface side thereof are provided inside of the second magnet roll **56**B and are disposed in a radial pattern along the circumferential direction of the second development sleeve **56**A. The pole S**1** which is a development pole is disposed at a position facing the latent image carrier **12**. Further, a transport pole N**1** is disposed adjacent to the development pole S**1** in the rotating direction of the second development sleeve **56**A indicated by arrow D, and a pickoff pole S**2** adjacent to the transport pole N**1**, a pickup pole S**3**, and a transport pole N**2** are disposed in this order.

Five permanent magnets each having an S-pole or an N-pole formed on the surface side thereof are provided inside of the first magnet roll **52**B and are disposed in a radial pattern along the circumferential direction of the first development sleeve **52**A. The pole N**3** which is a development pole is disposed at a position facing the latent image carrier **12**. Further, transport poles S**4**, N**4** are sequentially disposed adjacent to the development pole N**3** in the rotation direction of the first development sleeve **52**A indicated by arrow C, and a pickoff pole S**5** is disposed adjacent to the pole N**4**. Disposed adjacent to the pickoff pole S**5** is an opposing pole S**6** which faces the transport pole N**2** provided in the second magnet roll **5613**.

A separating member (splitting member) **68** is provided at the downstream side of the delivery portion **54** in the rotating direction of the first development roll **52** so as to extend along the longitudinal direction of the first development roll **52**. The separating member **68** hits against the developer G adhering to the second development roll **56** and separates (splits) the developer G for the first development roll **52** and the second development roll **56**.

As shown in FIG. **3**, the separating member **68** has an acute angled isosceles triangle-shaped cross section, and includes a separating portion (split portion) **70** and a shaft portion **72**. The separating portion **70** separates the developer G by an acute angled leading end **70**C hitting against the developer G (see FIG. **1**). The shaft portion **72** rotates integrally with the separating portion **70**. The shaft portion **72** is formed so as to project from each of both end surfaces in the longitudinal direction of the separating portion **70**. One shaft portion **72**A projecting from one end surface **70**A is supported rotatably by a bracket **74** fixed to the case body **50** (see FIG. **2**), and the other shaft portion **72**B projecting from the other end surface **70**B is fixed to an output shaft of a stepping motor **76** which is an example of a moving unit supported by the case body **50**.

Further, the stepping motor **76** is provided with a controller **78** which is an example of a control unit which controls the rotation angle of the stepping motor **76** to rotate and move the separating portion **70** so as to change the separation ratio (split ratio) of the developer G.

(Operation)

An electrostatic latent image on the latent image carrier **12** is, first, developed by the first development roll **52** moving in the direction opposite to the moving direction of the latent image carrier at the development nip GP**1**, and thereafter, is further developed by the second development roll **56** moving in the same direction as the moving direction of the latent image carrier at the development nip GP**2**, whereby a toner image is formed.

The flow of the developer is reverse. First, a developer layer is formed on the second development roll **56**, and thereafter, a part of the developer G is transferred by the separating member **68** to the first development roll **52**.

A detailed description is given below for the flow of the developer G.

As shown in FIG. **1** and FIG. **2**, in the developing device **18**, the developer G adheres to the surface of the second development sleeve **56**A from the first agitation-transport auger **58**

by the pickup pole S3, and is divided into a proper amount between the first development roll **52** and the second development roll **56** by the separating member **68** disposed in the vicinity of the transport pole N2, and thereafter, the divided developer is transported to the development pole S1, transport pole N1 and pickoff pole S2 along the rotating direction D. A toner on a magnetic brush in the vicinity of the development pole S1 is moved to the latent image carrier **12**, and an electrostatic latent image formed on the late image carrier **12** is made visible. The second development roll **56** moves in the same direction with respect to the latent image carrier **12** in the development nip GP2 facing the latent image carrier **12**, and therefore, the relative speed of the second development roll is small so rubbing-frictional force by the magnetic brush on the development roll **56** for a toner image can be reduced. Thus, an image quality having excellent graininess is obtained. Accordingly, microscopic non-uniformity of an image formed by the first development roll **52** disposed at the upstream side is corrected and an output image having a higher image quality is obtained.

In the vicinity of the pickoff pole S2, the developer G drops down from the surface of the second development sleeve **56**A so as to back to the accommodation chamber **50**B.

The developer G separated to the first development roll **52** by the separating member **68** in the delivery portion **54** is transported sequentially to the opposing pole Sb, the development pole N3, the transport pole S4, the transport pole N4, and the pickoff pole S5 along the surface of the first development sleeve **52**A, with accompanied by the first development sleeve **52**A rotating along the rotating direction indicated by arrow C. In the vicinity of the development pole N3, a toner on a magnetic brush moves to the latent image carrier **12**. The first development roll **52** moves in the opposite direction with respect to the latent image carrier **12** in the development gap GP1 facing the latent image carrier **12**, and therefore, the relative speed of the first development roll becomes large so there is an advantage that a high amount of development can be performed in even at a low rotational speed.

Accordingly, a more stabilized image quality can be obtained by performing control such that an amount of development required for obtaining image density is principally secured by the first development roll **52**.

Further, in the vicinity of the pickoff pole **85**, the developer G drops down from the surface of the first development sleeve **52**A and is guided by the guide plate **64**, and is placed back to the accommodation chamber **50**B.

Specifically, the developer G passes by the pickup pole S3 of the second development roll **56**, and thereafter, a layer of the developer with an amount sufficient for carrying out development by the two development rolls is formed by the layer forming member **62** uniformly in the axial direction.

Then, the developer G transported to the delivery section **54** hits against the separating member **68**, and a part of the developer is delivered (separated) from the second development roll **56** to the first development roll **52**.

Here, the transport pole N2 of the second development roll **56** and the opposing pole S6 of the first development roll **52**, which face each other in the delivery portion **54**, have different polarities, and therefore, magnetic brush of the developer G is formed in the delivery portion **54**. Accordingly, the developer G hits against the leading end **70**C (a peak point of the isosceles triangle) of the separating portion **70** so that the developer G can be separated into the first development roll **52** and the second development roll **56** without applying a large pressure to the developer G. Thus, as compared to a conventional method in which a layer regulating member is used for each of two development rolls, deterioration of the developer can be alleviated.

In this case, the separation ratio of the developer G to the first development roll **52** or the second development roll **56** is determined based on a position at which the leading end of the separating member **68** supported in rotatable and movable is stopped, and the ratio of circumferential speeds of the two development rolls.

As shown in FIG. **4**A, in a case in which the ratio of circumferential speeds of the second development roll **56** and the first development roll **52** is 1, and the amount of developer per unit area, adhering to the second development roll **56**, and the amount of developer per unit area, adhering to the first development roll **52** is made equal to each other, the controller **78** rotates and moves the separating member **68** such that a distance between the leading end **70**C of the separating portion **70** and the surface of the first development roll **52** and a distance between the leading end **70**C and the surface of the second development roll **56** substantially become equal to each other.

In a case in which the development property may be deteriorated depending on the environment, passage of time, use conditions, and the like, it is necessary to ensure the development property by increasing the circumferential speed of the first development roll **52**.

In this case, the amount of the developer transported by the second development roll **56** to the separating member **68** per unit area and per unit time is constant. However, the amount of developer transported to the first development roll **52** whose circumferential speed per unit time is increased. As a result, the amount of developer on the development roll **56** per unit area decreases. Accordingly, there are cases that a carrier of the developer G may transfer to the latent image carrier **12** so as to cause a failure in an output image, blur may occur due to decreasing in image correction effect, and deterioration of graininess may occur.

However, as shown in FIG. **4**B, the controller **78** activates the stepping motor **76** to rotate and move the separating member **68**, whereby at least the minimum amount of the developer G transported by the second development roll **56** is maintained (secured), and the above-described defects do not occur.

In regard to the development property, the sensitivity for the amount of developer per unit time, which developer passes through the development nip GP1, (i.e., the sensitivity with respect to the circumferential speed) is higher than that for the amount of developer per unit area on the development roll. Therefore, even though the amount of developer adhering to the first development roll **52** decreases, no problem occurs in the development property.

Further, even though carrier transfer or blur occur in the first development roll **52**, at the second development roll which is at the downstream side, collecting of carrier and correcting of an image are performed, so not leading to occurrence of any problem.

To the contrary, in a case in which the development property of the first development roll **52** becomes too high due to the environment, passage of time, use conditions, so that the image correcting effect in the second development roll **56** becomes small or lost, the circumferential speed of the first development roll **52** needs to be decreased. In this case, the amount of developer on the second development roll **56** per unit area increases, so there are cases that clogging of developer in the development nip may occur, rubbing may occur, and deterioration of graininess may occur.

However, as shown in FIG. **4**C, the controller **78** activates the stepping motor **76** to rotate and move the separation member **68**, thereby making it possible to reduce the amount of the developer adhering to the surface of the second development roll **56** to an extent where there is no problem.

In more detail, in a case in which the circumferential speed of the first developer roll **52** is made increased, as shown in FIG. **4**B, the controller **78** controls so that the leading end **70**C of the separating member **68** is moved to approach toward (close to) the first developer roll **52** whose circumferential speed is relatively increased, that is, the leading end **70**C of the separating member **68** is moved away from the second developer roll **56** whose circumferential speed is relatively decreased.

On the other hand, in a case in which the circumferential speed of the first developer roll **52** is made decreased, as shown in FIG. **4**C, the controller **78** controls so that the leading end **70**C of the separating member **68** is moved to approach toward (close to) the second developer roll **56** whose circumferential speed is relatively increased, that is, the leading end **70**C of the separating member **68** is moved away from the first developer roll **52** whose circumferential speed is relatively decreased.

As describe above, even in a case in which the ratio of circumferential speeds of the first development roll **52** and the second development roll **56** is varied, the ratio of the amounts of the developer G adhering to the first development roll **52** and the developer G adhering to the second development roll **56** can be maintained in a proper state by the separating member **68** being rotated and moved, and even though the environment, passage of time, and/or use conditions change, an excellent image quality can be constantly maintained.

Further, the separating member **68** is configured so as to rotate and move around the shaft potion **72**, and therefore, the separating member **68** moves by a simple structure.

Incidentally, the present invention is described above in detail with reference to a specific exemplary embodiment, but is not limited to such an exemplary embodiment and it is apparent to a person skilled in the art that other various exemplary embodiments are possible within the scope of the invention. For example, in the above-described exemplary embodiment, the transport pole N**2** of the first development roll **52** and the opposing pole S**6** of the second development roll **56** facing each other in the delivery portion **54** have different polarities, but the invention is not particularly limited to the same, these poles may have the same polarity.

Moreover, the above-described exemplary embodiment copes with changes of the development property caused by the environment, passage of time, use conditions and the like, by varying the circumferential speed of the first development roll **52**, but the invention is not particularly limited to the same. The circumferential speed of the second development roll **56** may be varied or the circumferential speeds of both the first development roll **52** and the second development roll **56** may also be varied.

Next, one example of each of a developing device, an assembly body and an image forming apparatus according to a second exemplary embodiment of the present invention are described with reference to FIG. **6** and FIG. **7**. Note that the same members as those of the first embodiment are denoted by the same reference numerals, and a description thereof is omitted.

As shown in FIG. **6**, a separating member **88** of the second exemplary embodiment has a rectangular cross section, and includes a separating portion **90** which separates the developer G in such a manner that one end **90**A thereof hits against the developer G, and a square pillar-shaped supporting portion **92** which supports the separating portion **90**. The supporting portion **92** is provided so as to project from each of both end surfaces of the separating portion **90** in the longitudinal direction. The each end side of the supporting portion **92** is supported by a moving member **94** which is an example of a moving unit which moves up and down the supporting portion **92**. Provided inside of the moving member **94** are a rail member which guides the supporting portion **92**, a gear member which lifts up the supporting portion **92**, and a stepping motor having a wire member wound on an output shaft (all of which are not shown) and the like.

Furthermore, the moving member **94** is provided with a controller **96** which is an example of control unit which controls the moving member **94** to move up and down the separating member **88**, so as to vary the separation ratio of the developer G. As shown in FIGS. **7**A, **7**B and **7**C, due to control of the controller **96**, the end **90**A of the separating portion **90** which separates the developer G is supported so as to move along a straight line F which connects the rotating axis of the first development roll **52** and the rotating axis of the second development roll **56**.

As described above, the end **90**A of the separating portion **90** which separates the developer G moves along the straight lien F. In other words, the end **90**A of the separating portion **90** moves along a magnetic line generated between the first development roll **52** and the second development roll **56**, and therefore, even if the separating portion **90** moves to any positions, the sensitivities of the developer G formed on the first development roll **52** and the second development roll **56**, and the end **90**A become equal, and the control becomes facilitated.

What is claimed is:

1. A developing device comprising:

a first developer holding member that is disposed to face a surface of a latent image carrier that rotates, the first developer holding member rotating such that a moving direction of the first developer holding member is opposite to that of the latent image carrier at a portion where the latent image carrier and the first developer holding member face each other;

a second developer holding member that is provided at a downstream side of the first developer holding member in a direction in which the latent image carrier rotates, and is disposed to face the surface of the latent image carrier, the second developer holding member rotating such that a moving direction of the second developer holding member is the same as that of the latent image carrier at a portion where the latent image carrier and the second developer holding member face each other, and a ratio of circumferential speeds of the first developer holding member and the second developer holding member being variable;

a splitting member that splits developer for the first developer holding member and the second developer holding member at a position between the first developer holding member and the second developer holding member, by hitting against the developer located between a surface of the first developer holding member and a surface of the second developer holding member;

a moving unit that moves the splitting member; and

a control unit that controls the moving unit to move the splitting member so as to vary a split ratio of the developer.

2. The developing device of claim **1**, wherein the splitting member includes a split portion that hits against the developer to split the developer, and a shaft portion that supports the

split portion rotatably at a downstream side in a direction in which the first developer holding member rotates.

3. The developing device of claim **1**, wherein the splitting member is supported so as to move along a straight line connecting a rotating axis of the first developer holding member and a rotating axis of the second developer holding member.

4. The developing device of claim **1**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved close to one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively increased.

5. The developing device of claim **1**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved away from one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively decreased.

6. An assembly body comprising:

a latent image carrier that rotates and in which an electrostatic latent image formed on a surface thereof is made visible as a toner image; and

the developing device including:

a first developer holding member that is disposed to face a surface of the latent image carrier, the first developer holding member rotating such that a moving direction of the first developer holding member is opposite to that of the latent image carrier at a portion where the latent image carrier and the first developer holding member face each other;

a second developer holding member that is provided at a downstream side of the first developer holding member in a direction in which the latent image carrier rotates, and is disposed to face the surface of the latent image carrier, the second developer holding member rotating such that a moving direction of the second developer holding member is the same as that of the latent image carrier at a portion where the latent image carrier and the second developer holding member face each other, and the ratio of circumferential speeds of the first developer holding member and the second, developer holding member being variable;

a splitting member that splits developer for the first developer holding member and the second developer holding member at a position between the first developer holding member and the second developer holding member, by hitting against the developer located between a surface of the first developer holding member and a surface of the second developer holding member;

a moving unit that moves the splitting member; and

a control unit that controls the moving unit to move the splitting member so as to vary a split ratio of the developer,

the developing device and the latent image carrier being assembled so as to be detachable with respect to a main body.

7. The assembly body of claim **6**, wherein the splitting member includes a split portion that hits against the developer to split the developer, and a shaft portion that supports the split portion rotatably at a downstream side in a direction in which the first developer holding member rotates.

8. The assembly body of claim **6**, wherein the splitting member is supported so as to move along a straight line connecting a rotating axis of the first developer holding member and a rotating axis of the second developer holding member.

9. The assembly body of claim **6**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved close to one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively increased.

10. The assembly body of claim **6**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved away from one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively decreased.

11. An image forming apparatus comprising:

an assembly body including:

a latent image carrier that rotates and in which an electrostatic latent image formed on a surface thereof is made visible as a toner image; and

the developing device including:

a first developer holding member that is disposed to face a surface of the latent image carrier, the first developer holding member rotating such that a moving direction of the first developer holding member is opposite to that of the latent image carrier at a portion where the latent image carrier and the first developer holding member face each other;

a second developer holding member that is provided at a downstream side of the first developer holding member in a direction in which the latent image carrier rotates, and is disposed to face the surface of the latent image carrier, the second developer holding member rotating such that a moving direction of the second developer holding member is the same as that of the latent image carrier at a portion where the latent image carrier and the second developer holding member face each other, and the ratio of circumferential speeds of the first developer holding member and the second developer holding member being variable;

a splitting member that splits developer for the first developer holding member and the second developer holding member at a position between the first developer holding member and the second developer holding member, by hitting against the developer located between a surface of the first developer holding member and a surface of the second developer holding member;

a moving unit that moves the splitting member; and

a control unit that controls the moving unit to move the splitting member so as to vary a split ratio of the developer,

the developing device and the latent image carrier being assembled so as to be detachable with respect to a main body; and

a transfer member that transfers, to a member to be transferred, the toner image formed on the surface of the latent image carrier provided in the assembly body.

12. The image forming apparatus of claim **11**, wherein the splitting member includes a split portion that hits against the developer to split the developer, and a shaft portion that

supports the split portion rotatably at a downstream side in a direction in which the first developer holding member rotates.

13. The image forming apparatus of claim **11**, wherein the splitting member is supported so as to move along a straight line connecting a rotating axis of the first developer holding member and a rotating axis of the second developer holding member.

14. The image forming apparatus of claim **11**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved close to one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively increased.

15. The image forming apparatus of claim **11**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved away from one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively decreased.

16. An image forming apparatus comprising:

a latent image carrier that rotates and in which an electrostatic latent image formed on a surface thereof is made visible as a toner image;

the developing device including:

a first developer holding member that is disposed to face a surface of the latent image carrier, the first developer holding member rotating such that a moving direction of the first developer holding member is opposite to that of the latent image carrier at a portion where the latent image carrier and the first developer holding member face each other;

a second developer holding member that is provided at a downstream side of the first developer holding member in a direction in which the latent image carrier rotates, and is disposed to face the surface of the latent image carrier, the second developer holding member rotating such that a moving direction of the second developer holding member is the same as that of the latent image carrier at a portion where the latent image carrier and the second developer holding member face each other, and the ratio of circumferential speeds of the first developer holding member and the second developer holding member being variable;

a splitting member that splits developer for the first developer holding member and the second developer holding member at a position between the first developer holding member and the second developer holding member, by hitting against the developer located between a surface of the first developer holding member and a surface of the second developer holding member;

a moving unit that moves the splitting member; and

a control unit that controls the moving unit to move the splitting member so as to vary a split ratio of the developer; and

a transfer member that transfers, to a member to be transferred, the toner image formed on the surface of the latent image carrier.

17. The image forming apparatus claim **16**, wherein the splitting member includes a split portion that hits against the developer to split the developer, and a shaft portion that supports the split portion rotatably at a downstream side in a direction in which the first developer holding member rotates.

18. The image forming apparatus claim **16**, wherein the splitting member is supported so as to move along a straight line connecting a rotating axis of the first developer holding member and a rotating axis of the second developer holding member.

19. The image forming apparatus claim **16**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved close to one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively increased.

20. The image forming apparatus claim **16**, wherein in a case in which the ratio of circumferential speeds of the first developer holding member and the second developer holding member is varied, the control unit controls so that a leading end portion of the splitting member which hits against the developer is moved away from one of the first developer holding member or the second developer holding member, whose circumferential speed is relatively decreased.

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